931-117 Triggered Acquisition of Ultrasound Images Improves Contrast Effect by Reducing Microbubble Destruction

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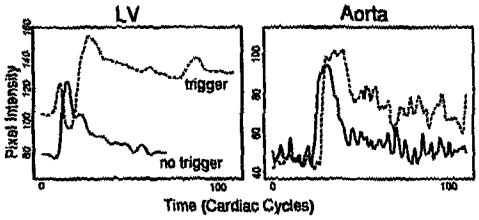
Triggered ECG-gated acquisition improves intensity and persistence of echocardiographic contrast. We hypothesized that this effect may be due to reduced microbubble destruction with abbreviated exposure to the insonifying beam. A canine model was utilized to evaluate the effect on contrast intensity in R-wave triggered (T) and non-triggered (NT) modes during conventional (CONV) or second harmonic (SH) imaging at 2 different output powers: 0 and −9 dB. Serial doses of MRX-115 (0.05 or 0.1 ml) were injected IV, during cardiac insonification with a prototype Acuson XP10. Simultaneously, the abdominal aorta was imaged with a Hewlett Packard Sonos 1500. Videodensitometric off-line analysis was done by placement of ovoid regions of interest in the left ventricular (LV) cavity, and within the cross-section of the abdominal aorta (Ao). For matched doses and output powers, the peak and mean pixel intensity differences between the T and NT modes were significant ($p < 0.001$). The figure below shows time intensity curves acquired in both T and NT modes for LV and Ao at 0dB.



Conclusions: Increased strength and duration of acoustic power output enhances destruction of microbubble delivery. Improvement of echocardiographic contrast intensity and duration may be achieved by intermittent triggered insonification.

931-118 Power Output-Dependent Destruction of Echocardiographic Contrast Agents by Conventional Ultrasound Imaging Systems

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Opacification of the left ventricle by ultrasound contrast agents often appears spatially inhomogeneous and varies within the cardiac cycle. We have observed these effects with several highly persistent contrast agents when imaged with high transmit power. Ventricular opacification and contrast persistence improved at lower transmit power. We sought to investigate the impact of ultrasound intensity on contrast persistence in vivo and in vitro. AF0145 (Imagent® US, Alliance Pharmaceutical Corp.) 0.3 or 0.6 mg/kg IV was administered to closed-chest dogs during cardiac insonification with an Acuson XP10 at 2.5 MHz. The power output was altered from −9 to 0 dB on sequential injections. Simultaneously, the right carotid artery was imaged with a modified ATL Ultramark 9 equipped with a 5 MHz linear array second harmonic transducer. Time intensity curves were constructed from carotid images at 0.2 sec intervals. Time to half maximal pixel intensity (THP) was determined for each injection. Saline phantoms containing 1 mg AF0145 in 250 ml were continuously insonified using the Acuson XP10 at −9 dB, −6, −3, or 0 dB for 5 min at 37°. The insonification power was briefly reduced to −9 dB every 30 sec for measurement of pixel intensities. The time intensity curves obtained in vivo differed from one another (sequential paired t-tests, $p < 0.0001$) with lower pixel intensities recorded during increased power output. The THP was inversely related to power output: 4.0, 5.4, 15.2, and 29.9 sec for 0, −3, −6, and −9 dB, respectively. Similarly, in the in vitro experiment, persistence of contrast was decreased by continuous exposure to higher energies, as noted by THP: 36, 80, 117, and 257 sec for 0, −3, −6, and −9 dB, respectively.

Conclusions: The acoustic effect of ultrasound contrast agents is destroyed by ultrasound in a dose-dependent manner. This effect occurs at clinically utilized outputs and must be considered when comparing imaging systems and agents. However, since contrast agents may exhibit significant nonlinearity in their response to different insonification energies, lower transmit powers may not always provide improved contrast enhancement.

931-119 Impact of Gain Setting on the Relation Between Concentration of Ultrasound Scatterers and Video Intensity: Implications for Clinical Studies Using Myocardial Contrast Echocardiography

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The relation between scatterer concentration and video intensity is critical for estimation of myocardial blood flow using contrast echocardiography. Although previous studies have examined this issue, the influence of variable ultrasound gain settings on such a relation has not been defined. To this end, we analyzed video intensity signals obtained from a phantom containing 4 standards of known particle concentration (3.5, 7.8, 11.7, 26.3 scatterers/mg) suspended in tissue-mimicking gel. Ultrasound images were acquired at 12 different gain settings (typically used during clinical studies) and fed into a Macintosh computer using a video frame grabber. For each standard, mean grey value was measured using customized software. Lateral dropout variations were compensated for by applying a polynomial function for background correction. For each gain setting, an exponential equation best defined the relationship between concentration (x) and pixel grey value (y):

$$y = ae^{(-bx)} + c$$

where a, b, and c are constants derived for each of the 12 ultrasound gain settings studied. Of note, the rate of decay (b) of the exponential curves varied by nearly 30% (29.3%) for the different gain settings studied in the clinically relevant operating range. This variability markedly affected the discriminatory power of the grey scale for each gain setting, especially at the lower scatterer concentrations. Thus, gain setting importantly influences the relation between concentration of ultrasound scatterers and video intensity. These findings have meaningful implications for video analysis in clinical studies of myocardial contrast echocardiography, and are particularly relevant for the investigation of conditions associated with reduced myocardial blood flow.

931-120 Effect of Second Harmonic Imaging Upon Left Ventricular Contrast Enhancement Produced by Albunex®

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Since contrast microbubbles in an ultrasonic field resonate, but tissue does not, imaging at a harmonic of the carrier frequency may augment contrast effect. However, no data are available as to whether the albumin coating of microbubbles damps resonation and inhibits enhancement by second harmonic imaging (2nd H). Thus, we performed fundamental and 2nd H using a prototype device (Acuson) in 15 pts during contrast echo. Separate injections of Albunex (0.15 cc/kg) were performed for fundamental and 2nd H in each pt during imaging in the apical 4C view. Measures of duration(DUR) and % LV chamber opacified (%OP) were derived. Videointensity was measured from a 4 mm^2 ROI placed in the mid LV cavity(CAV) and septum (IVS). Results:

	DUR (sec)	%OP	IVS	CAV	CAV/IVS
Fund	15	63%	53.3	54.5	1.08
2nd H	18	78%	30.7*	67.1	2.45+

*$p < 0.05$, +$p < 0.001$).

Qualitative assessment (scale 0 = no contrast to 3+ = complete cavity opacification) was superior for 2nd H to fundamental (mean 2.1 vs 1.1 respectively, $p < 0.001$). No myocardial opacification could be visualized during 2nd H. Thus, 2nd H imaging augments the LV cavity contrast enhancement produced by Albunex, particularly relative to tissue, although the duration of contrast is unchanged. These data indicate that 2nd H imaging is of value in enhancing the LV cavity contrast effect produced by Albunex.

931-121 Cardiac Ultrasound Using Second Harmonics and Intravenously Administered Albumin Shell Microspheres

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Because of the resonant features of ultrasound contrast agents, significant signal information is obtained from the second harmonic (HARM) which depends in part on the contrast agent studied. Therefore, 5 unconscious mongrel dogs were studied with intravenous Albunex (air-filled) and FS069 (perfluoropropane-filled), both albumin spheres. A prototype Hewlett Packard HARM system and a Sonos 1500 conventional (CONV) system were used, the former employed 2.5 MHz fundamental and 5.0 MHz HARM and the latter a 5 MHz transducer. Multiple paired injections of Albunex (8–9 ml)